Samantha Rae G. Mandani. Check Yourself Before You Wreck Yourself: Evaluating for Inclusive and Equitable Themes in Online Resources for Information Technology Competency Tests. A Master's Paper for the M.S. in I.S. degree. May, 2020. 63 pages. Advisor: Casey Rawson

This research study focused on online resources of information technology competency tests. I used online resources of a fellow SILS student's research project developing self-guided learning modules to lower the barrier of entry for incoming students required to take the information technology competency test at the School of Information and Library Science at UNC. I used those resources and existing online resources from the current competency test and developed short working guidelines by using evaluation tools analyzing inclusive and equitable themes of accessibility, readability, and learning approaches. The results indicated that despite great value in utilizing evaluation tools, algorithms are insufficient in determining what is inclusive and equitable. Human intervention and involvement can make the biggest impact in deciding how online resources are evaluated in order to reduce or eliminate unnecessary barriers for the incoming students.

Headings:

Online resources

Evaluation tools

Digital literacy

University Design for Learning

Equity

Inclusion

Learning approaches

Readability

Accessibility

CHECK YOURSELF BEFORE YOU WRECK YOURSELF: EVALUATING FOR INCLUSIVE AND EQUITABLE THEMES IN ONLINE RESOURCES FOR INFORMATION TECHNOLOGY COMPETENCY TESTS

by
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Introduction

Various universities and college programs across the United States have implemented information technology competency tests as part of their educational requirements for their incoming students as tangible demonstration of students' facility with technology and digital environments. Considering the speed in which society demands the use of digital media, online tools, and technology, it feels like an appropriate expectation to have for students advancing their career with a college or professional degree. The School of Information and Library Science (SILS) at the University of Chapel Hill, North Carolina employs an information technology competency test "designed to confirm [your] facility" of various technology competencies that involve "1. basic internetworking tools, 2. standard office productivity software, and 3. creating well-formed web documents" ("Information Technology", n.d.). A fellow graduate student at SILS is conducting her own research project that aims to update the technology competency assessment for incoming SILS students from a traditional take-home test format into a self-guided learning module. It includes the same concepts that are on the current assessment but will arguably provide a clearer path to make learning or reviewing these concepts into one that is approachable and empowering to the students completing the test. The undertaking of that research project builds upon improvements of the organization, presentation, and compilation of materials for that test. My research study then takes the online resources from that project and builds upon it while investigating

inclusive and equitable themes so that incoming students can better assess their learning needs and, ultimately, own their learning and education.

The approachability and empowerment that comes with this project is due largely to the desire to improve overall accessibility for all incoming students who must take the test in order to determine if they can opt out of an Information Technology survey semester-long course. My specific research study will use the existing online resources and the ones that the SILS student researcher has compiled alongside a short list of evaluation tools to determine a set of guidelines on how best to review online resources for accessibility, readability, and learning approaches. Those three concepts are what I am using as my barometers of inclusion and equity for this study.

Websites and online resources are not created equally or with accessibility in mind simply because they are on the Internet. Similarly, lists of online resources do not necessarily consider inclusive and equitable themes simply because they have been compiled as resources for an information technology competency test. I believe that there is value in reviewing these aspects of learning in academic institutions despite being such a niche topic, because creation and development of educational content should involve inclusion, diversity, and equity from the start. Therefore, when devising and planning this research study, I created specific parameters to determine which evaluation tools are used in this study bearing in mind those inclusive and equitable themes. My goal is not to judge or critique the online resources for how ‘good’ or ‘bad’ they are because it is not as important which online resources are being tested. What matters most is how it is being tested and what tools are being used to assess them in order to create a resource list for information technology competency tests. My hope is to develop a type of working

guidelines that can be replicated and/or modified by others to make their own assessments and other tests inclusive and equitable, accessible and empowering to those who must take them. After all, if incoming students are expected take and pass these technology competency assessments to show that they have a working understanding of these concepts, then it should also be an expectation that the information and content that is provided to them has been reviewed to be inclusive and equitable so as to reduce, if not eliminate, any unnecessary barriers that may impede their success at school.

Literature Review

Technology Competency Tests

Technology competency tests and requirements have surged over the years due to the growing need and expectation of technology fluency to meet the demands of a rapidly burgeoning digital environment. As the population of students going into the Library and Information Science (LIS) field diversifies based on their exposure and experience with technology, graduate programs are employing these technology competency requirements to "ensure that incoming students are fully prepared to begin their education and succeed in an academic environment that has become largely dependent on technology (Scripps-Hoekstra et al., 2014). Kules and McDaniel's (2010) content analysis examined not just the knowledge and skills required and expected from incoming students, it also even provided a means of remediation and reassessment. However, it does not address how resources within these information technology requirements are assessed for inclusion and equity. In fact, not a lot of research currently exists in terms of assessing the online resources used in those information technology competency tests to be more inclusive and equitable for the students who are required to take them.

Vannata and Banister (2008) assessed the impact of these tests on their incoming education students since there are similar expectations with future LIS professionals that these would-be teachers should have an adequate level of technology proficiency so as to prepare them for their future careers. According to the article, students received access to

the test and supplemental tutorials prior to taking it. However, the links in the article are no longer viable which makes determining if these tutorials and educational materials ever considered inclusive and equitable themes. Such a result is expected as the information and content available on the Internet does not automatically guarantee unlimited lifespan and therefore are at the mercy of content providers maintaining their websites. Despite the occurrence of non-viable links, or dead links, in research articles, it is still helpful for this research study to know that other institutions and academic fields provide supplemental resources designed to help students reach proficiency and/or mastery about technology competencies. More importantly, if such resources are offered for required technology competency assessments, then it is even more important to evaluate them for accessibility barriers and issues.

Lowering the barrier in information technology competency tests

To create more inclusive and equitable information technology competency tests does not necessarily indicate that the test has lowered the rigor. Instead, the focus is on creating an environment in which an incoming student required to take an assessment has the same level of opportunity in being successful as their peer. That is the nature of my fellow SILS student researcher's project with transforming the current technology competency test into something that is more approachable and empowering into a self-guided learning module. The same requirements are still present in the self-guided learning module, but the aim is to present the test and its accompanying online resources to be more approachable and empowering to those who have to use them. It is that approachability that helps to lower the barrier of entry for information technology competency tests because it understands and accepts that incoming students are arriving

to this academic program with varied exposure and experiences to information technology, digital tools and devices.

Focus on online resources

Information technology competency requirements can vary from institution to institution on quality, content, and rigor which is a respectable research topic. However, my interests are directed to online resources because they are what I perceive to be the gateway to learning. The SILS information technology competency test, specifically, presents itself passively as a PDF file with hyperlinks that direct incoming students taking the test to a variety of online resources meant to assist them in understanding and completing the listed tasks. The engagement between the student and the test comes exclusively from the student. Therefore, if the online resources linked in these tests are not considered and evaluated for potential inclusion and equity barriers, I argue that they can lose interest, engagement, focus, and momentum into learning the concepts and completing the tasks to the best of their ability. Mhouti et al. (2013) specifically address the value of digital learning resources (a term I consider synonymous with online resources) because they purport the following:

> A brief survey on these resources offers abundant evidence that authors frequently fail to apply design principles that have been established in the fields of instructional design, instructional psychology and the learning sciences. Further, many resources appear never to have been learner-tested or subjected to other processes of evaluation. In our view, there is a quality problem that demands a multifaceted solution involving better education of digital learning resources designers and design and development of models that incorporate quality assessment. (p. 28)

The lack of review and evaluation for quality of digital learning or online resources can be a cause of unforeseen and unnecessary barriers for students that could detract away from strengthening curiosity and engagement with learning. I propose that it is not

enough to just create an inclusive and equitable test, but to recognize that that effort needs to be extended to the resources used because that is where a lot of self-teaching and learning can appear.

Digital Literacy

Technology competency tests imply and expect a level of digital literacy from those who must take them as they are required to access the test, navigate the test, and conduct the test on various applications and software. Digital literacy defined first by Paul Gilster in his book, Digital Literacy (1997), "is the ability to understand and use information in multiple formats from a wide range of sources when it is presented via computers" (p. 1). He asserts that digital literacy "places demands upon you that were always present…[At] the same time, it conjures up a new set of challenges that require you to approach networked computers without preconceptions" (p. 2). Indeed, as we ponder on the requirements for the SILS information technology competency test mentioned earlier, we find the technical requirements but also the underlying critical thinking skills involved to execute those tasks.

Eshet-Alkalai (2004) has since proposed a more holistic approach to also include five other literacies within digital literacy: (a) photovisual literacy; (b) reproduction literacy; (c) information literacy; (d) branching literacy; and (e) socio-emotional literacy. As technology competency tests require students to meet a certain threshold of understanding proficiency, the online resources supplemented within the tests are all the more essential to help contextualize information needed to accomplish the tasks. Checking those online resources for inclusive and equitable themes can help to further refine a student's incoming digital literacy level. Additionally, digital literacy should be

looked at as a malleable and growing concept, especially as technology continues to be innovated upon and transform the way learners and users interact with information. As this particular area of information sciences evolve, it is easy to fall into the trappings of potential gatekeeping by way of delineating specific definitions for what passes and fails to meet these definitions. However, as we learn more about the impact of inclusion and equity, diversity and accessibility on digital literacy as a whole, I defer to Bawden's (2001) assertion of open explanations of these terms rather than restrictive defining because "labels attached to these concepts do not matter; the concepts themselves, and their significance for practice, do" (p. 24). Assessment of online resources for inclusive and equitable themes, in the grand scheme of digital literacy, can benefit from a more flexible approach because inclusion and equity exist in the context, in case-by-case bases, and in the cracks of human flaws of judgment.

Inclusion and Equity

Inclusion, defined by the American Library Association (ALA), is "an environment in which all individuals are treated fairly and respectfully; are valued for their distinctive skills, experiences, and perspectives; have equal access to resources and opportunities; and can contribute fully to the organization's success" ("ODLOS Glossary of terms," 2019). Though this definition is functioning under the presumption of libraries as a whole, its definition still pertains to this research study. More notably, the specific choice of inclusion to be an environment underscores how information technology competency tests can be their own environments for the incoming students required to take them. As such, the test should treat the students fairly and respectfully with regards to their learning needs.

Equity, defined by the ALA, "assumes difference and takes difference into account to ensure a fair process and, ultimately, a fair (or equitable) outcome" ("ODLOS Glossary of terms," 2019). This definition particularly highlights the value of differences that can contribute to more empathetic considerations for incoming students' educational needs.

These two terms should be inherent parts of the construction of information technology competency tests. They are fundamental in ensuring that the components and parts of the assessment respect the various groups of people that will interact with it.

Accessibility

Accessibility, as Kettler et al. (2018) defined it, is the "extent to which a product, environment, or system eliminates barriers and permits equal use of components and services for a diverse population of individuals" further declaring that "optimal accessibility is implicitly promised to all students" and its delivery is "a shared responsibility for educational stakeholders" (p. 1). As the competency test, online resources, and evaluation tools exist exclusively on the Internet, their success to be inclusive and equitable to their users rely on accessibility. Thus, it is the first inclusion and equity category for this research study. Web accessibility, in particular, is vital to the construction of the competency test as well as the online resources used to supplement it. If there is an expectation and requirement for an incoming student's use of digital tools and devices, it is therefore important to have access to them. Web accessibility also notes the significance of ensuring that information and content can reach all types of people, particularly those with special needs and disabilities. Such an assessment like an information technology competency test that relies on an understanding of use of technology, i.e. digital tools and devices, should be available without barriers to students.

Of course, without barriers to students is the ideal, but is not always the case. Stone and Cook (2018) assert that despite the best of intentions, there will be people who cannot fully access the test due to cognitive and physical barriers at least not without accommodations or modifications (p. 65). Though they address accessibility barriers in the realm of K-12 education and assessments, their points still apply here. Assessments themselves need to be accessible, but for the nature of information technology competency tests, there is a great need to compile online resources that are accessible. It's through the online resources that are presented to incoming students that represent what the test creators and resources compiler deem as the recommended direction of the program/department/institution whether they're aware of it or not. These resources are also the first things that the incoming students will see when taking the competency test before widening their search, as these are the resources provided for by the test.

Another reason for bridging accessibility and technology competencies is to prioritize the students' ownership of their education by eliminating as many unnecessary obstacles as possible. In a study done by Rodriguez-Ascaso et al. (2016), the students provided information about their accessibility preferences for eLearning systems. Though this research study is not something that we are evaluating for this particular research study, it is helpful to note that students, when given the chance, will set their own accessibility preferences in order to have a more impactful user experience with the interface from which they are learning. It stands to reason that this should be considered and accommodated for a test that they are taking to show their own technology competency. By evaluating online resources for accessibility can help speak to some of

these preferences and make the learning process much more concrete and attainable for students.

Readability

Readability is "what makes some texts easier to read than others. It is often confused with legibility, which concerns typeface and layout" (DuBay, 2004, p. 3). Formulas such as Flesch-Kincaid Reading Ease, Gunning FOG Index, SMOG Index (all formulas in the readability evaluation tools) have evolved and iterated on over time to score texts and determine their readability to better understand reading abilities and literacy. DuBay explains criticisms of discrepancies among these formulas citing causes such as different variables (formulas test against different variables like syllables, word counts, etc.), different criterion scores (formulas do not have a standard pass/fail criteria to test against), different algorithms (algorithms process formulas differently), and the problem of optimal difficulty ("different uses of a text require different levels of difficulty") (p. 56) which can target the credibility of readability tests. However, I still propose that it is a valuable category for inclusion and equity as readability checks how textual content is consumed by readers. Incoming students are not all native or fluent English speakers, so it is critical that the textual content of the online resources used within the competency test are amenable to its users. For those who are not native English speakers, it is these online resources supplementing the test that can provide them a direction on how to proceed with their tasks. Assessing for readability thresholds is crucial in allowing non-native English speakers the space to work from a place of strength. DuBay's article concludes that research on literacy has highlighted the various causes for limited reading abilities of learners and as a response, research on readability has then highlighted factors that affect the success of literacy (p. 57). Thus, measuring

with readability supports those inclusive and equitable themes as it emphasizes support for reading abilities.

Learning styles into learning approaches

Learning styles have been hotly debated by multiple scholars for some time now. Supporters of learning styles argue that learning styles are providing a framework and vocabulary for instructors and learners to identify their learning preferences (Bernard et al., 2017). A notable interpretation (Felder and Soloman, 1993), of learning styles present learners into different types: active and reflective learners, sensing and intuitive learners, visual and verbal learners, and sequential and global learners. Critics of this framework, on the other hand, argue that it inadequately explains and presents itself as a viable framework and theory because it falls short in a myriad of reasons including, but not limited to, presenting valid measures, explaining mechanisms, and to failing to link to achievement (An and Carr, 2017, "Higher education," 2017). An and Carr instead have suggested alternative approaches, labeled in this research study as 'learning approaches', which they claim are "supported by cognition and development theories, and by the temperament and personality theories" (p. 412) that mitigate and address the inadequacies present in the learning styles argument. I use a couple of the suggested learning approaches later on as components of my analysis.

Regardless of the longstanding debate about learning styles, especially as a framework and pedagogical tool, learning approaches should still be deemed as a critical piece in evaluating for inclusive and equitable themes specifically because of how it prioritizes differences (in this case, through the ways individuals learn) and the impact that has on learners. Since this research study focuses on online resources and learning from them in order to complete tasks in a competency test, it only feels appropriate to

evaluate learning approaches. As established previously, incoming students come from different backgrounds and have varying experiences and exposure to technology. The same can be said for the various ways in which they learn, process, and review information.

Universal Design for Learning

Universal Design for Learning (UDL) is an educational framework that consists of three principles best summarized from Dell et al. (2015) in the following:

> "Principle 1, presentation, involves providing learners with various ways of acquiring information and knowledge. Principle 2, action and expression, provides students with various routes for demonstrating what they know. Principle 3, engagement and interaction, enables an instructor to tap into students' interests, challenge them appropriately, and motivate them to learn. (p. 167)

UDL, by and large, is a relevant framework to discuss within the context of inclusion and equitable themes because its very purpose is to ensure that the design of instructional and pedagogical materials is inclusive and accessible for all learners. It appears to be driven by the multiplicity in representation, expression, and engagement (Katz, 2013) which results in widely covering the ranges of learning needs and accessibility for diverse learners. Katz explains UDL in the context of inclusive education that has particular focus on the "Three-Block Model of UDL" which consists of "System & Structures, Inclusive Instructional Practice, and Social and Emotional Learning" (p. 192) that pertains more into instruction and teaching and creating an environment conducive to promoting inclusive education. UDL does not seamlessly translate into the purposes of this study due to the involved nature of UDL especially with instruction and pedagogy. Instead it acts as a reinforcing framework that echoes various points of accessibility, readability, and learning approaches.

Methodology

For this research study, I attempt to answer this research question: How to evaluate online resources used to supplement or support information technology competency tests for inclusive and equitable themes?

I am using content analysis for my study to analyze existing online resources and evaluation tools in order to assess for inclusive and equitable themes. Using content analysis is the best approach for this research study because it is an evaluation of already existing materials on the Internet. It is also the best approach because of its ties to the SILS student researcher's project.

My sample collection uses the online resources embedded in the SILS Information Technology Competency test (Batch 1) as well as the online resources that the SILS student researcher is using for her self-guided learning module project (Batch 2), both listed in full in the Appendix A. Using these collections, I explore their contents and how well they are measured by evaluation tools and developing guidelines from those results.

My sampling method is a non-probability purposive sampling technique because it was sourced from the SILS student researcher's list of resources that she wanted to use for her project. Therefore, all of the population were tested. This is helpful because the focus is not the sampling but what is being sampled.

The biggest limitation of purposive sampling is the bias attached to it since it has been selected by someone else as opposed to being selected at random. Additionally, I recognize that these two small batches and short list of evaluation tools are not representative of the entire population of online resources and websites that exist on the Internet that information technology competency tests can implement and use. However, these limitations are justifiable within the context of this research study because the sample is what the SILS student researcher has selected for her project, therefore whatever she chose were used for this study. It's a non-issue for this to not be representative of the entire online resources population because the research project is geared towards the specific focus of addressing the test for SILS.

Mhouti et al.'s 2013 study, "How to evaluate the quality of digital learning resources?" created an evaluation instrument that calculates the resource using four distinct aspects: academic quality, pedagogical quality, didactic quality, and technical quality (p. 29). Academic quality pertains to the reliability and relevance of information. Pedagogical quality pertains to pedagogical formulation, construction, and strategies as well as assessment method. Didactic quality pertains to learning activities and learning content. Technical quality pertains to the design, browsing, and technological ingenuity. Their evaluation instrument is a viable option for this research as these aspects overlap with inclusive and equitable themes, however I maintain creating my own working guidelines as my research interests align with that of accessibility and user experience surrounding inclusion and equity. The tree structure of the evaluation instrument is available in the Appendix B.

Trustworthiness

I established dependability of my research study by honestly describing any problems or challenges that arose as I conducted my analysis. I expressed as much clarity about my decisions as possible. I established my credibility through my deference to already existing research, especially about learning approaches. I showed findings whether positive or negative as a means of maintaining objectivity. I also maintained transparency as I explained my specific judgment calls and executive decisions as the primary researcher and tried to be clear about the rationale behind those calls. I also provided appendices of supplementary information such as terms and definitions from the evaluation tools.

I collaborated with a fellow SILS student with this study insomuch that we became sounding boards for one another during the planning stages of our respective research endeavors. We maintained regular meetings with one another discussing our progress, but any tangible contribution that she provided for this research study pertains only to the list of online resources she compiled for her self-guided learning module project. We believed that though our respective work influenced one another, neither were required to proceed with the research. In other words, the results of my research study did not affect the overall process or outcome of her project.

Data Collection

Using existing data by way of online resources for this research study means that it is readily available to be checked and used. The use of existing resources is central for

the SILS student researcher's self-guided learning module because the focus is lowering the barrier of entry in building technology competencies and not necessarily the creation of educational materials to be incorporated into her project. With that in mind, my content analysis reinforces that notion. Online websites as existing data also means that their availability assumes and requires physical and cognitive accessibility to a computing device and the Internet. A notable point is that the existing data, being on the Internet, may easily disappear or be modified without any kind of forewarning. There is a risk of its availability if the owner(s) of the websites decides to take the pages of their content down for whatever reason. It is within their right to do so because they are providing the information for free to the general public.

For this content analysis, I placed both resource collections (Batch 1 and Batch 2) through a series of evaluative tests. To determine that series, I created a simple yet strict set of parameters to determine which tools I would use: (a) It must not cost money to use. (b) It must not have a membership barrier that requires signing up and logging in to use. (c) It must not require downloading additional software onto the computing device to use. Creating such strict parameters yielded a small set of evaluation tools. However, I believe that creating this parameter before testing adheres to inclusive and equitable themes because they only need the use of a computing device and access to the Internet. Though my focus for this study is on supporting more inclusive and equitable creation of information technology competency tests, these parameters help to make the whole process accessible for those who may wish to adapt it for their own purposes. I do acknowledge that paying for services, gaining membership, or allowing additional

software can become factors for more robust evaluation tools beyond what is presented here.

The accessibility and readability categories underwent tests using evaluation tools found readily and freely on the Internet. There were no financial or membership barriers into using these tools, at least at the time this study was conducted. The learning approaches category did not yield any evaluative tool because learning approaches typically focus more on addressing a learner through teaching methods (An and Carr, 2017). However, as stated previously, this article addressed alternatives to learning styles, labeled in this study as learning approaches. I used two of the recommendations as they were more suited and applicable to the purposes of this study.

The following information provides descriptions for each of the tools and their components.

Web Accessibility Evaluation Tool (WAVE) *https://wave.webaim.org/*

It is an evaluation tool created by a non-profit group called Web Accessibility in Mind (WebAIM) at Utah State University. It uses the international standard Web Content Accessibility Guidelines (WCAG) 2.0 as reference for their results. They have divided the categories into six main parts: Errors, Contrast Errors, Alerts, Features, Structural Elements, and ARIA. Each category includes a series of potential elements that can be flagged, though they do not all indicate a negative reason for flagging. The details of what gets flagged is available in the Appendix C. The first three categories (Errors, Contrast Errors, and Alerts) serve to inform the user of any issues that may exist within the webpage that could pose accessibility issues. The latter three categories (Features, Structural Elements, and ARIA) serve to inform the user of elements within the webpage

that adhere to accessibility guidelines of the WCAG 2.0. The WAVE tool provides users with the option to check a singular webpage using a web page address or URL and nothing more. The website does offer alternative means of further utilizing the WAVE tool that includes browser extensions, APIs, and "enterprise-level reporting and tracking of accessibility" (*WAVE Web Accessibility Evaluation Tool*, n.d.). For the purposes of this research study, I focused solely on entering a web page onto the entry field as that was the default and only option.

Web Accessibility Checker *https://achecker.us/checker/index.php*

This project was created by the Inclusive Design Research Centre at OCAD University in Canada. The AChecker is an open-source software made to check "single HTML pages for conformance with accessibility standards to ensure the content can be accessed by everyone" ("Inclusive design research centre," n.d.). The AChecker tool provides users with three ways through which they can check a webpage for accessibility: Web Page URL, HTML File Upload, and Paste HTML Markup. The Web Page URL is the same as the WAVE tool where the web address is entered into the text field. The HTML File Upload offers users the ability to upload their .html or .htm files. The Paste HTML Markup provides a textbox into which users can paste their HTML code. There are further Options that users can select depending on their needs including what guidelines are used to check and the reporting format of any problems. The Options screenshot in the Appendix C provides a full list of available options. The AChecker defaults to the WCAG 2.0 (Level AA) standard.

AChecker categorizes the results of the website evaluation through three types of problems: Known problems, Likely problems, and Potential problems. Known problems

have identified problems “with certainty” and requires modification to the webpage to fix the problems. Likely problems have identified problems that are “probably barriers” but specifically note requiring a human decision. Potential problems have identified problems that the AChecker algorithm cannot identify and specifically requires human decisions to determine if it adheres or conflicts with accessibility.

Readability Test Tool *https://www.webfx.com/tools/read-able/*

This readability tool is created by WebFX, a digital marketing agency. They use six readability tests: Flesch Kincaid Reading Ease, Flesch Kincaid Grade Level, Gunning FOG Score, SMOG Index, Coleman Liau Index, and Automated Reader Index. These readability tests assess a myriad of variables including syllable count, word count, and U.S. grad levels. A full list of explanations of each test is listed in the Appendix C.

The Readability Test Tool provides users with three different modes of input: Test by URL, Test by Direct Input, Test by Referrer. Test by URL is similar to the WAVE tool and the AChecker in that it provides users an entry field into which they can paste a web address. The Test by Direct Input requires a user to copy and paste all the text directly into a text box. A notice of “HTML is allowed – it will be stripped from the text” on this page suggest that copying HTML code directly is permitted. The Test by Referrer offers users the means to test the readability of a whole page or of a single area of the page by inserting their own HTML code into the source material. Despite having the option of Test by Direct Input available on this tool similarly to that of the Automated Readability Checker, I decided to use the Test by URL for this study as it provided the most convenient and easiest means of using the tool in comparison to the other options.

This tool also provides Text Statistics, which includes information on the number of sentences, number of words, number of complex words, percent of complex words, average words per sentence, and average syllables per words. I decided to omit this information from the comparison with Automatic Readability Checker as they did not have similar features. As the researcher, I believe there can be value in assessing these figures but maintain that since the other tool did not offer this feature, it was easier to keep them as even as possible.

Automatic Readability Checker *https://readabilityformulas.com/free-readability-formula-tests.php*

This readability tool is created by Reading Formulas, a site for readability tools and resources. Along with Readability Test Tool, they use the same six readability tests. The only difference is that the Automatic Readability Checker adds a seventh test using Linsear Writing Formula, "originally developed for the United States Air Force to help them calculate the readability of their technical manuals…specifically designed to calculate the United States grade level of a text sample based on sentence length and the number words used that have three or more syllables" ("How to use the linsear write readability formula to grade your text," n.d.).

There is only one option that a user has in using this tool and that is by copying and pasting their text directly into the textbox. They make a note about limiting sample sizes to 3000 words. There is also a required Security Check feature with a checkbox that asks "Are you human?" with the only option as "Yes. (Click the box)".

The WAVE, AChecker, and Readability Test Tool evaluation tools all had options to insert a URL directly into their calculators or copy and paste the content

directly into a text box. For the purposes of this study, I placed the URLs and calculated their results in this manner as it was the default setting that they offered when landing on their websites. For Automatic Readability Checker, the only option was to copy and paste the content into the text box provided. This particular part of the study required my manual intervention of copying and pasting the content from each website that I believed to be most relevant to the topic it was addressing. Therefore, I did not copy and paste information from the header section, the footer section, or any information that I believed did not immediately pertain to the presented topic within the page.

Despite the debates surrounding it, Learning Styles do offer a variety of surveys and questionnaires for individuals to take in order to assess what type of learner they are (Delahoussaye, 2002). The surveys and questionnaires themselves are geared towards humans taking them and not for evaluating online resources, thus my rationale for adapting the recommended learning approaches. As there were no learning approaches evaluation tool that I could find during the allotted time of this research study, I adapted two of the recommended approaches from An and Carr and created a question for each to use as a measure for every online resource. Since this particular section has the most manual intervention, I posed questions that required initial Yes or No responses but still provided space for explanations.

The first approach: *Individual differences in sensory-based skills better explain verbal-visual styles* (p. 412). This translates to assessing the representation of the content in more than one way. This is the question that I posed to represent this: **Does the online resource present information and/or content in more than one way?**

The second approach: *Expert-novice differences better explain concrete-abstract styles* (pp. 412). This translates to assessing the content for how the linked online resource offers learners opportunities to extend that learning. This is the question that I posed to represent this: **Does the online resource provide avenues for further exploration of the subject or topic?**

The other alternative learning approach listed in the article, "Individual differences in cognitive processes and personality better explain impulsive-reflective styles" (p. 413) were insightful on their own, but I believe they were better suited for implementation in long term and more active lesson planning and instructional engagement. It would not be as relevant to evaluating pre-existing online resources. I recognize that there could have been possibilities of incorporating the other approach to create a more involved set of questions, but since I am not an expert on instructional design or pedagogy in that way, I wanted to use parts that I felt were most relevant as I understood them.

The accessibility and readability categories have two evaluation tools to use for the purposes of comparing the test results within a data collection and not as a competition of which tool evaluates the online resource better. The learning approaches category does not have two evaluation tools but does have two questions that function together to assess the online resource as a whole. The goal of running these tests is to determine the kinds of guidelines needed to assess and evaluate online resources for inclusion and equity themes.

Data Analysis

The results from both collections are not intended to be compared directly against each other, but instead against the tools used to yield their results. For example, the results from Batch 1 using the WAVE tool is not getting compared with the results from Batch 2 using the WAVE tool. However, results from Batch 1 using the WAVE tool will get compared with the results from Batch 1 using the AChecker tool based on how the WAVE tool and the AChecker tool performed.

Additionally, any comparisons between Batch 1 and Batch 2 are intended only for any pattern discovery that may appear.

The data also does not demand any decoding or using some kind of coding handbook as, again, it is not so much the data results of the tests that are being considered but the performance of the tools to use for the tests.

Batch 1 Accessibility Results

Using WAVE: https://wave.webaim.org/

Batch 1: Accessibility						
Resource links	**Error**	**Contrast Errors**	**Alerts**	**Features**	**Structural Elements**	**ARIA**
https://bellard.org/jslinux/	1	0	10	0	9	0
http://validator.w3.org/#validate_by_upload	0	0	10	48	14	0
http://jigsaw.w3.org/css-validator/#validate_by_upload	7	0	4	43	20	0
https://www.file-extensions.org/extensions/common-file-extension-list	2	860	52	523	46	0
https://www.webopedia.com/TERM/W/word_processing.html	25	21	20	5	23	4

Batch 1: Accessibility						
https://www.webopedia.com/TERM/S/spreadsheet.html	22	19	17	4	19	4
https://www.webopedia.com/TERM/R/RDBMS.html	22	19	17	4	17	4
https://support247webs.com/windows-traceroute/	1	1	10	8	18	14
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87	9	20	65	4	57	36

Initial observations from the WAVE tool bring attention to the Contrast Errors that exist for https://file-extensions.org/extensions/common-file-extension-list which flags over 850 components on this webpage that signify low contrast exist between the foreground and background elements. However, it also brings attention to over 500 features present on this website. These features indicate that certain elements are incorporated to adhere and accommodate to the WCAG 2.0. What these observations can suggest is that these webpages can exist with conflicting elements.

Another observation comes from the ways in which multiple webpages from the same website seem to accrue similar data points. Webopedia.com has garnered similar numbers across the board suggesting that they may be utilizing the same HTML codes across the website.

Aside from potential outlier behavior from a couple of websites, the rest of the online resources did not seem to have such egregious errors to signify a failure with integrating accessibility into their site. Nevertheless, it underscores the need for clarification on a couple of points: what constitutes as ‘egregious errors’ and who is defining it?

Using AChecker: https://achecker.us/checker/index.php

Batch 1: Accessibility			
Resource links	**Known Problems**	**Likely Problems**	**Potential Problems**
https://bellard.org/jslinux/	2	8	39
http://validator.w3.org/#validate_by_upload	0	0	255
http://jigsaw.w3.org/css-validator/#validate_by_upload	0	0	0
https://www.file-extensions.org/extensions/common-file-extension-list	0	0	0
https://www.webopedia.com/TERM/W/word_processing.html	178	1	390
https://www.webopedia.com/TERM/S/spreadsheet.html	38	0	368
https://www.webopedia.com/TERM/R/RDBMS.html	38	0	358
https://support247webs.com/windows-traceroute/	3	1	197
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87	73	13	328

Interestingly, the same https://www.file-extensions.org/extensions/common-file-extensions-list that the WAVE tool flagged with hundreds of errors did not get flagged with any such problems through AChecker. The same goes for the http://jigsaw.w3.org/css-validator/#validate_by_upload. It raises the question that if both of these tools perform their tests using the WCAG 2.0 as reference, how are their algorithms then parsing those references and determining their results?

AChecker's Potential Problems serve to highlight the need for human intervention and human review as the algorithm has assessed that hundreds of components within the webpage is worth a second examination. Potential Problems do not automatically indicate a failure of the website to provide accessible options for their users. Instead, it points to

various components throughout the webpage that would and could benefit to be more accessible. Since it was not marked as Known Problems, there seems to indicate a degree of leeway and grace that the algorithm has left for human examination to pick up.

Batch 1 Readability Results

Using Readability Test Tool: https://www.webfx.com/tools/read-able/

Batch 1: Readability								
Resource links	**Grade Level**	**Age**	**Flesch Kincaid Reading Ease**	**Flesch Kincaid Grade Level**	**Gunning FOG Score**	**SMOG Index**	**Coleman Liau Index**	**Automated Readability Index**
https://bellard.org/jslinux/	7	12-13	57.3	6.7	4.8	5.9	13.3	4.7
http://validator.w3.org/#validate_by_upload	5	10-11	68.5	5.9	5.7	6.2	6	0.4
http://jigsaw.w3.org/css-validator/#validate_by_upload	7	12-13	61.5	6.5	6.6	5.9	11.7	4.3
https://www.file-extensions.org/extensions/common-file-extension-list								
https://www.webopedia.com/TERM/W/word_processing.html	7	12-13	46.3	7.9	4.8	6.8	10.9	2.1
https://www.webopedia.com/TERM/S/spreadsheet.html	6	11-12	44	7.9	5.6	5	11.6	2.1
https://www.webopedia.com/TERM/R/RDBMS.html	8	13-14	26.2	10.5	5.1	6.8	13	3.5
https://support247webs.com/windows-traceroute/	7	12-13	65.1	6.2	8.4	7	11.2	4.2
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87	11	16-17	34.6	9.2	14.5	6	19.4	8.3

The file-extensions.org, when placed through the Readability Test Tool did not load any results. Instead, it refreshed the page to the homepage. I tried to insert the URL

into the entry field five times across three different browsers: Safari, Google Chrome, and Brave. None of them yielded any such results and therefore did not get counted onto the table. This raises the question of what is the algorithm reading and calculating to determine this outcome?

Using Automatic Readability Checker by ReadingFormulas:
https://readabilityformulas.com/free-readability-formula-tests.php

Batch 1: Readability									
Resource links	**Grade Level**	**Age**	**Flesch Kincaid Reading Ease**	**Flesch Kincaid Grade Level**	**Gunning FOG Score**	**SMOG Index**	**Coleman Liau Index**	**Automated Readability Index**	**Linsear Write Formula**
https://bellard.org/jslinux/	9	13-15	35.2	9.7	7.3	7.2	16	8.2	3.2
http://validator.w3.org/#validate_by_upload									
http://jigsaw.w3.org/css-validator/#validate_by_upload									
https://www.file-extensions.org/extensions/common-file-extension-list	49	College grad	-69.5	54.9	54.1	26.3	12	66.5	85.5
https://www.webopedia.com/TERM/W/word_processing.html	12	17-18	47.5	11.2	14	10.8	13	12.1	12.6
https://www.webopedia.com/TERM/S/spreadsheet.html	10	14-15	56.4	8.7	10.8	8.2	13	9.7	7.5
https://www.webopedia.com/TERM/R/RDBMS.html	12	17-18	43.5	11.5	15.5	11.2	12	11.4	12.3
https://support247webs.com/windows-traceroute/	9	13-15	57.4	9	11.6	9.7	9	7.9	9.3
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87	11	15-17	48.7	10.6	11.7	9.3	13	11.7	10.8

Two online resources did not get any test results because I, as the researcher, made the executive decision that there were no substantial types of texts that I could copy and paste from the two validator websites into the textbox of the readability checker.

The evaluation tools for readability use nearly the same types of tests, yet they yielded vastly different results from one another. One particular result is from the same link as mentioned in the accessibility section, the file-extensions.org webpage. Automatic Readability Checker, as I have copied and pasted onto its textbox, seem to suggest that this particular webpage requires college graduate age and an obscenely high value for the grade level. In the defense of this particular webpage, the file-extensions.org do not provide full sentences and paragraphs that could be measured. Instead it's a long table full of file extension names and descriptions that can be deemed jargon heavy. As a result, for someone to create an information technology competency test, compiling resources that include such jargon-heavy language should be evaluated with context in mind.

Additionally, the results from the two evaluation tools do not indicate much alignment in their results which rears a potential issue of what parts of the whole webpage are being calculated by the algorithms.

Batch 1 Learning Approaches Results

Using adapted Learning Approaches questions:

Batch 1: Learning Approaches		
Resource links	**Representation: Does the online resource present information and/or content in more than one way?**	**Novice to Expert: Does the online resource provide avenues for further exploration of the subject or topic?**
https://bellard.org/jslinux/	No; text	Yes; content hyperlinks
http://validator.w3.org/#validate_by_upload	No; text	Yes; content hyperlinks
http://jigsaw.w3.org/css-validator/#validate_by_upload	No; text	Yes; content hyperlinks
https://www.file-extensions.org/extensions/common-file-extension-list	Yes; text, images	Yes; content hyperlinks
https://www.webopedia.com/TERM/W/word_processing.html	Yes; text, images	Yes; content hyperlinks, related terms, topic comparisons
https://www.webopedia.com/TERM/S/spreadsheet.html	No; text	Yes; content hyperlinks, related terms
https://www.webopedia.com/TERM/R/RDBMS.html	No; text	Yes; content hyperlinks, related terms
https://support247webs.com/windows-traceroute/	Yes; text, images	Yes; content hyperlinks
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87	No; text	Yes; content hyperlinks, drop-down menu options

As stated previously, these questions were answered by me at my discretion of how I comprehended them. I tried to answer the question with a Yes or No response and provided the means in which the presentation is offered, e.g. via text, images, etc. Of the 9 links, 5 of them showed only text which could point to a myriad of plausible conjectures and rationales. I am not interested in those reasons so much as I am interested in the consequences of those reasons primarily that can pose a learning barrier for someone who learns better when text is accompanied by audio or visuals.

This current list provided by the SILS information technology competency test does not present more than one learning approach for their incoming students. Again, it does not automatically categorize these resources as inherently inaccessible to various learners or that the content is not adequate or appropriate, just that it can pose a barrier for those seeking to learn it. For the learners, they may have to contend with learning through text alone and seeking information elsewhere that can address their learning needs better. Fortunately, there are content-related hyperlinks offered in every single resource link that could address those learning needs.

Batch 2 Accessibility Results

Using WAVE: https://wave.webaim.org/

Batch 2: Accessibility						
Resource links	**Errors**	**Contrast Errors**	**Alerts**	**Features**	**Structural Elements**	**ARIA**
https://www.w3schools.com/html/	6	10	46	7	47	8
https://www.w3schools.com/html/html_intro.asp	5	20	37	7	52	8
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element	4	288	16	26	76	83
https://www.w3schools.com/html/html_lists.asp	7	63	27	6	80	8
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596	14	0	14	34	54	179
https://www.youtube.com/watch?v=sx4kaeyzQzw	8	0	7	1	4	67
https://www.youtube.com/watch?v=U4UHoiK6Oo4	8	0	7	1	4	67
https://www.w3schools.com/css/default.asp	5	12	48	7	44	8
https://www.w3schools.com/css/css_intro.asp	5	9	36	6	44	8
https://www.w3schools.com/css/css_howto.asp	5	33	38	6	51	8
https://www.w3schools.com/css/css_text.asp	5	19	39	6	42	8
https://www.w3schools.com/sql/default.asp	6	10	44	7	45	8

Batch 2: Accessibility						
https://www.w3schools.com/sql/sql_select.asp	6	9	34	6	51	8
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874	5	0	17	5	50	64
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/	7	0	3	1	19	5
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm	7	0	1	1	22	5
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm	9	0	2	9	33	7
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm	7	0	2	9	30	5
https://database.guide/microsoft-access-tutorial/	2	13	8	0	24	45
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6	15	0	34	5	46	80
https://www.davidbaumgold.com/tutorials/command-line/	3	20	4	1	24	2
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference	0	0	2	2	16	9
https://www.youtube.com/watch?v=jDINUSK7rXE	9	0	7	1	4	70

The results from this test reaffirm an earlier point made from Batch 1 results using the WAVE tool. Multiple online resources coming from the same website seem to use the same web coding infrastructure which could contribute to the similarities in their yielded data points. The best way to confirm this would be to look into the code itself and compare.

Another point to consider with regards to multiple links from the same website is that if a particular webpage seems to exhibit certain errors or features, it is not unlikely to experience similar errors and features on other pages within that website. Looking into qhmit.com seem to support that observation with 3 out of the 4 links flagging the same number of errors and the same number of ARIA components present. With that said, this

observation can inform the decisions of someone compiling online resources for their assessment. Understanding the extent to which a website adheres or conflicts with accessibility guidelines can be a good starting point to determine further use of content from the same source.

Using AChecker: https://achecker.us/checker/index.php

Batch 2: Accessibility			
Resource links	**Known Problems**	**Likely Problems**	**Potential Problems**
https://www.w3schools.com/html/	9	2	439
https://www.w3schools.com/html/html_intro.asp	13	1	427
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element	13	15	486
https://www.w3schools.com/html/html_lists.asp	11	1	481
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596	22	0	339
https://www.youtube.com/watch?v=sx4kaeyzQzw	11	1	220
https://www.youtube.com/watch?v=U4UhoiK6Oo4	11	1	220
https://www.w3schools.com/css/default.asp	9	2	474
https://www.w3schools.com/css/css_intro.asp	13	1	780
https://www.w3schools.com/css/css_howto.asp	8	1	460
https://www.w3schools.com/css/css_text.asp	8	1	447
https://www.w3schools.com/sql/default.asp	8	2	789
https://www.w3schools.com/sql/sql_select.asp	8	2	770
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874	8	1	298
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/	21	0	174
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm	26	0	153
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm	21	0	223

Batch 2: Accessibility			
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm	24	0	208
https://database.guide/microsoft-access-tutorial/	4	0	184
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6	36	1	340
https://www.davidbaumgold.com/tutorials/command-line/	5	16	104
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference	0	0	326
https://www.youtube.com/watch?v=jDINUSK7rXE	8	1	221

Known Problems and Likely Problems across the board yielded lower numbers determined by the algorithm. One website, codecademy.com, did not even register any problems. These can be helpful to people compiling resources as they can see that despite known and established issues, these websites may show promise. Conversely, it's important to note that simply because a website flags very little, if any, errors in such an evaluation tool does not automatically indicate relevance and value to the test.

Most interesting from these results, however, are the hundreds of Potential Problems present in every single link signifying that there are several guidelines that ought to be further examined, particularly by a human. These results seem to suggest that the algorithm could assess only to the extent of their programming but did facilitate a structured means of better review and examination.

Batch 2 Readability Results

Using Readability Test Tool: https://www.webfx.com/tools/read-able/

Batch 2: Readability								
Resource links	**Grade Level**	**Age**	**Flesch Kincaid Reading Ease**	**Flesch Kincaid Grade Level**	**Gunning FOG Score**	**SMOG Index**	**Coleman Liau Index**	**Automated Readability Index**
https://www.w3schools.com/html/	9	14-15	56.1	7.6	5.4	8	15.2	7.7
https://www.w3schools.com/html/html_intro.asp	8	13-14	59	7.3	5.5	7.8	13.9	6.8
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element	8	13-14	62.6	6.6	9	7	12.8	5.6
https://www.w3schools.com/html/html_lists.asp	7	12-13	66.4	5.8	4.8	6.5	12.3	4.7
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596	6	11-12	64.6	5.1	5.8	5.1	12.7	3.4
https://www.youtube.com/watch?v=sx4kaeyzQzw	5	10-11	68	4.8	3.9	5.3	8.4	0.1
https://www.youtube.com/watch?v=U4UHoiK6Oo4	5	10-11	65.1	5.3	3.7	5.5	8.9	0.6
https://www.w3schools.com/css/default.asp	9	14-15	55.4	7.8	5.3	8	14.9	7.7
https://www.w3schools.com/css/css_intro.asp	9	14-15	57.1	7.8	5.6	8.2	14.3	7.7
https://www.w3schools.com/css/css_howto.asp	8	13-14	59.8	7.2	6.2	7.7	13.4	6.6
https://www.w3schools.com/css/css_text.asp	9	14-15	55	8	5.4	8.1	14.5	7.7
https://www.w3schools.com/sql/default.asp	10	15-16	50.3	9.2	6	8.9	15.7	9.6
https://www.w3schools.com/sql/sql_select.asp	10	15-16	47.6	9.6	5.9	9.2	15.4	9.6
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874	7	12-13	60.3	5.6	6.6	4.8	14.7	4.6

Batch 2: Readability								
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/	5	10-11	66	5.1	3.7	4.9	10.8	2.1
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm	8	13-14	57.7	6.9	6.8	6.3	15.1	5.8
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm	6	11-12	73.5	4.7	5.1	5.1	10	2.6
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm	5	10-11	73.7	4.7	4.6	4.6	10.1	2.8
https://database.guide/microsoft-access-tutorial/	9	14-15	50.6	7.8	6.8	6.8	15.7	6.9
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6	8	13-14	56.3	6	4.5	4.5	16.3	5.6
https://www.davidbaumgold.com/tutorials/command-line/	7	12-13	72.1	6	6.7	6.7	9.7	4.6
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference	7	12-13	63.6	6	6	6	12.1	4.2
https://www.youtube.com/watch?v=jDINUSK7rXE	5	10-11	66	5.2	5.3	5.3	10.1	1.7

One notable observation from this table comes from the YouTube video links and how their Grade Level and Age results were identical to one another. The rest of the results for those links were not identical but were similar to one another. Since this tool was able to produce data results for YouTube links, it raises the same question as it did from Batch 1 in terms of what the algorithm is reading and calculating to produce this outcome. Furthermore, the file-extensions.org website from Batch 1 did not produce any type of results despite multiple attempts, however these YouTube video links did which

not only reinforces that same question but also piques exploration as to what components are deemed readable or unreadable by the algorithm of this tool.

Using Automated Readability Checker: https://readabilityformulas.com/free-readability-formula-tests.php

Batch 2: Readability									
Resource links	**Grade Level**	**Age**	**Flesch Kincaid Reading Ease**	**Flesch Kincaid Grade Level**	**Gunning FOG score**	**SMOG Index**	**Coleman Liau Index**	**Automated Readability Index**	**Linsear Write Formula**
https://www.w3schools.com/html/	7	11-13	72.6	5.8	8	7.1	9	5.6	5.8
https://www.w3schools.com/html/html_intro.asp	10	14-15	58.8	9.9	11.4	9.36	9	9.9	12.2
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element	10	14-15	60.4	10.2	13.3	9.8	8	10.4	13.7
https://www.w3schools.com/html/html_lists.asp	7	11-13	68.5	6.8	7.7	7	9	6.1	6.5
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596									
https://www.youtube.com/watch?v=sx4kaeyzQzw									
https://www.youtube.com/watch?v=U4UHoiK6Oo4									
https://www.w3schools.com/css/default.asp	6	10-11	76.8	5.5	7.9	6.4	7	4	6
https://www.w3schools.com/css/css_intro.asp	8	12-14	70.5	7.3	9.7	8.1	8	7.1	8.6
https://www.w3schools.com/css/css_howto.asp	10	14-15	61.4	9.8	12.7	9.6	8	9.4	13
https://www.w3schools.com/css/css_text.asp	11	15-17	54.9	12.4	13.9	8.7	6	11	15.9
https://www.w3schools.com/sql/default.asp	10	14-15	57.3	9.25	9.7	9.4	11	9.6	9.4

Batch 2: Readability									
https://www.w3schools.com/sql/sql_select.asp	13	18-19	23	13.7	8.8	11.1	15	12.1	11
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874									
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/	11	15-17	55.9	11.2	11.8	9.2	8	10.6	14
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm	10	14-15	50	10.2	11.2	9.1	11	9.7	9.3
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm	7	11-13	68.3	7.4	8.8	6.8	8	6.8	7.7
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm	7	11-13	70	7	7.6	5.5	8	6.4	6.9
https://database.guide/microsoft-access-tutorial/	9	13-15	55	11	10.6	8.1	8.9	8.1	8
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6									
https://www.davidbaumgold.com/tutorials/command-line/	7	11-13	69.6	7.1	9.6	7.4	8	6.1	7.8
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference	8	12-14	60.9	8.2	10.6	8.2	9	6.8	7.8
https://www.youtube.com/watch?v=jDINUSK7rXE									

One of the biggest issues that I faced as I tested these links on both the evaluation tools was how to address non-textual resources. Left blank on the second table using Automatic Readability Checker are for resource links of YouTube videos. As this particular evaluation tool relied on human intervention to copy and paste information, I did not and could not determine what to copy and paste into the textbox because YouTube as an interface is mostly a combination of the comments section and related

videos with video thumbnails and titles. Since the purpose of the YouTube link is the video, I deemed that there was nothing textual for me to copy and paste that would accurately represent the video that's being used. Thus, I made the executive decision to leave these blank as I did not want to use any part of the webpage that isn't the content of the video to skew the results. As noted previously, the Readability Test Tool provided results for these YouTube videos which raises the question of what is being calculated by the algorithms to generate these results? Is it the contents of the description? Is it the comments section? Is it the titles of the related videos? If so, I would argue that it does not consider the readability of the contents of the video, i.e. the transcription of the video itself. Therefore, as I examine the results of the YouTube videos from Readability Test Tool, I do so with some hesitation.

Batch 2 Learning Approaches Results

Using the adapted Learning Approaches questions:

Batch 2: Learning Approaches		
Resource links	**Representation: Does the online resource present information and/or content in more than one way?**	**Novice to Expert: Does the online resource provide avenues for further exploration of the subject or topic?**
https://www.w3schools.com/html/	Yes; text, interactive editor	Yes; examples, exercises, interactive editor
https://www.w3schools.com/html/html_intro.asp	Yes; text, images, interactive editor	Yes; content hyperlinks, interactive editor
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element	Yes; text, images	Yes; linked outline, table of contents, content hyperlinks, related items
https://www.w3schools.com/html/html_lists.asp	Yes; text, interactive editor	Yes; index, content hyperlinks, interactive editor

Batch 2: Learning Approaches		
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596	Yes; text, video, transcription	Yes; learning objectives, skills tags, q&a feature
https://www.youtube.com/watch?v=sx4kaeyzQzw	Yes; video, closed captions*	Yes; related videos*
https://www.youtube.com/watch?v=U4UHoiK6Oo4	Yes; video, closed captions*	Yes; related videos*
https://www.w3schools.com/css/default.asp	Yes; text, interactive editor	Yes; interactive editor, exercises, quiz, test
https://www.w3schools.com/css/css_intro.asp	Yes; text, interactive editor	Yes; content hyperlinks, related terms, interactive editor
https://www.w3schools.com/css/css_howto.asp	Yes; text, interactive editor	Yes; exercises, interactive editor
https://www.w3schools.com/css/css_text.asp	Yes; text, interactive editor	Yes; interactive editor
https://www.w3schools.com/sql/default.asp	Yes; text, interactive editor	Yes; examples, content hyperlinks, related terms, references, quiz/test
https://www.w3schools.com/sql/sql_select.asp	Yes; text, images, interactive editor	Yes; exercises, interactive editor
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874	Yes; video, transcription	Yes; exercises, content hyperlinks, related terms
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/	No; text, image*	Yes; table of contents, content hyperlinks, related terms
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm	No; text, image*	Yes; related topic descriptions, content hyperlinks, related terms
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm	Yes; text, images	Yes; highlighted tips of relevant information
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm	Yes; text, images - screenshots	Yes; highlighted tips of relevant information
https://database.guide/microsoft-access-tutorial/	Yes; text, images	Yes; content hyperlinks, related terms
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6	Yes; text, videos, transcription	Yes; table of contents, content hyperlinks, related terms

Batch 2: Learning Approaches		
https://www.davidbaumgold.com/tutorials/command-line/	No; text	Yes, topic headings, hyperlinks tok related terms and topics
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference	Yes; text, examples	Yes, topic headings, hyperlinks to related terms and topics, table of contents
https://www.youtube.com/watch?v=jDINUSK7rXE	Yes; video, closed captions*	Yes; related videos*

The results of the representation question show an overwhelming number of Yes responses which suggest that these resources can address various learning needs. I specifically asterisked the results that garnered an original Yes, but with some caveats. 3 of the 5 asterisked resource links are YouTube videos where I pointed out that these links provided both a video and closed caption. However, the closed captions were auto-generated by the algorithms of YouTube and are prone to mishearing or misinterpreting the words that are being spoken. With that said, closed captions are typically available in a lot of videos and provide an avenue of learning for those who may not be able to hear the words or sounds. The more inclusive and equitable alternative would be to provide a human-verified transcription of the video that is accessible and downloadable for the user.

The remaining asterisked resource links both come from the same website and the same series of tutorials on databases. The asterisks pertain to the use of images within the webpage. Despite having images on the webpage, the images are not informational so much as they are just decorative. The two particular images are screenshots of the database software but do not provide any substantial information or content to learn about the database itself. Therefore, I made the decision to answer negatively to this question

for those webpages. Perhaps an argument can be made that having a screenshot in general may be a mode of representation, but I based my decisions on seeing how the caliber of other images from other websites served more inherently functional in the steps of learning. Alternatively, the screenshot could have been a series of screenshots that accompanied each new piece of information so that the text and the image could be used in conjunction of one another.

Similar to Batch 1 results for learning approaches, all of the resource links provide further extension of learning and review for the learners. However, what I appreciated from this set of resource links is the diversity of extended learning that can be considered by the user. Not only are there content hyperlinks, but there are interactive editors, tables of contents, modules, and other resources to access. They offer some more direction for users to pursue to extend their learning which can increase their proficiency on the elements being tested for in information technology competency tests. An additional benefit to this kind of extended learning is contextualizing the lessons and the information to the learner. This kind of engagement can also be empowering to learners as they wield the power to make decisions of their learning within the provided webpages.

Discussion

The all-encompassing takeaway from this content analysis points to the need for human intervention, human guidance, and human review of these online resources. Despite online resources existing abundantly on the Internet, there is no guarantee that the content provided has been automatically considered and vetted for inclusion and equity.

For accessibility, evaluative tools that follow the industry standard guidelines, the Web Content Accessibility Guidelines 2.0, can be a great start to see if content being presented is, at minimum, meeting those standards. Additionally, the errors and alerts that have been highlighted are not automatic indictments to the correctness of the online resources. It does not inherently require someone well-versed in digital and web accessibility to make decisions based on the results, though it does help. Instead, using tools like WAVE and AChecker provide points for manual intervention. They provide the jargon and the vocabulary to investigate what types of human interventions are required to mark necessary changes to make or check that the online resources promote inclusive and equitable themes.

For readability, the main consideration from this content analysis is to determine what constitutes as relevant and consumable content being provided to the user. Both the Readability Test Tool and the Automatic Readability Checker utilized a suite of tests to determine the readability levels of the content within the online resource. However, it is unclear what is being included and excluded within those tests to produce those

numerical results. Readability Test Tool may consider all the textual information present on the webpage that include, but are not limited to, the header sections, the footer sections, and navigation panes. Without the full knowledge of what text is being included or excluded within the suite of tests, the results may come across as biased or inaccurate. Though I exercised human intervention with the Automatic Readability Checker, I had to make certain decisions that specifically omitted certain sections of the webpage based on what I believed to be relevant and pertinent information. However, as I am not an information technology competency test creator, I could have very well omitted certain sections that could have been useful for the overall test.

For learning approaches, especially under the context of information technology competency tests, the biggest takeaway from this study would be the importance of regarding and understanding that all learners are complex individuals who have various needs. Despite the requirements that may be necessary within the competency test, there is room for improving inclusive and equitable practices when learning approaches are being considered. Having more options than purely descriptive or prescriptive text can become much more engaging and open to learners. The value that learning approaches pose for those compiling resources is to consider the resources and content through asking questions of what is being learned, how is it being learned, and why is it being learned. Those are the questions that the Universal Design for Learning ask within the scope of instruction and learning but it is my recommendation to answer those questions whenever possible.

Working Guidelines & Impact

As this is a research study that assesses one particular aspect of a particular test in a particular setting, my recommendations within this working guideline is subject to changes and revisions as necessary. I reiterate that I am not an expert in this field of study and therefore could have missed several opportunities of exploration and analysis that I did not cover here. However, one of the goals of this study is to open conversation about making inclusion and equity integral parts of the creation process, especially when it comes to providing students and other learners supplemental materials and online resources that will eliminate unnecessary barriers to success.

Provided below is a table with my recommendations for measuring online resources that utilize both online evaluation tools and human intervention. Despite the learning approaches category not having an algorithm-driven evaluation tool, the questions from this research study can be used as part of the overall evaluation tool.

Working Guidelines for Measuring Online Resources for Inclusion and Equity

Guidelines for Measuring Online Resources for Inclusion and Equity		
	Online Evaluation Tool	**Human Intervention**
Accessibility	- Uses standard guidelines like Web Content Accessibility Guidelines (WCAG 2.0)	- Someone who is familiar with web accessibility concepts and terminology - Someone who is familiar with HTML coding
Readability	- Uses readability tests with formulas to calculate relationships between words and syllables - Uses readability tests with formulas to calculate relationship with U.S. grade level	- Someone who is familiar with the U.S. education system and grade levels, - Someone who is fluent in English

Guidelines for Measuring Online Resources for Inclusion and Equity		
Learning Approaches	- Considers multiple representations for learning - Creates a space for extending, practicing, or reviewing knowledge	- Someone who is familiar with learning objectives - Someone who is familiar with digital literacy

The evaluation tools that I used in this research study fits in my recommendations for evaluating online resources. I would also go so far as to suggest that if test creators and resource compilers have the means to a budget, membership, and use of additional software to test against these categories, they can still determine which tools to use by referring to this guideline. Additionally, the Human Intervention column does not require expertise to enact inclusive and equitable review of online resources. Granted, having an expert who is knowledgeable with these topics and concepts would certainly help with refining the online resources to be as inclusive and equitable as appropriate for the context of the competency test. However, in the maintained spirit of inclusion and equity, this research study aims to be friendly and approachable, even to the test creator and/or resource compiler. Thus, this is the recommendation of working guidelines that I would suggest to the SILS student researcher as she composes and compiles online resources for her self-guided learning module project.

Ultimately, the human intervention should be applied in conjunction with the online evaluation tools as it is through their joint partnership that determines context, variability, and appropriateness of materials and resources that can be used for the information technology competency tests.

Considerations, Limitations and Further Research

Universal Design for Learning is a framework that I considered for the learning approaches section of the testing. However, I felt at odds with how UDL focuses a lot on teaching and instruction over time. The most prevalent issue I came up against was the way in which these online resources are typically static webpages that passively provide information to the learner. Even with interactivity built in, as with the case of the W3 Schools sites with their coding editors, these are resources that exist to present information passively to whoever comes upon it.

Another consideration worth noting is the assessment of non-textual resources such as video, audio, and graphics that have their own parameters to deliberate on that include, but are not limited to, transcriptions and alternative texts. Though I tested on resource links that included videos and images, I deemed non-textual resource evaluation under the big umbrella of Accessibility.

One limitation of my study's design is the small sample size, both in evaluation tools and online resources. Therefore, the limitation comes from having such strict parameters that determined evaluation tools and using online resources chosen by someone else. I could have missed out on evaluation tools that addressed more than my chosen categories for inclusion and equity, and the SILS student researcher could have missed out on resources out there that already exhibit a lot of inclusive and accessible materials.

Another limitation is that I am the sole and primary researcher that develops the working guidelines to better evaluate online resources using evaluation tools and will therefore be limited to my working capabilities and my own biases as I have understood

these topics and concepts. Though I am interested and invested in ensuring educational materials and resources are accessible for all, I do not have any expert background in these subjects, just familiarity with the concepts through my education and exposure in graduate school.

Various educational institutions and organizations may be interested in my study's findings to review for inclusive and equitable themes in the educational content, assessment, and work in their own materials and resources. I also think that third party websites and resources that are offering instructional or educational information could be interested or impacted by my study's findings especially if they are focused on creating more inclusive, equitable, and diverse materials for people to consume.

As for my research study's delimitations, I did not work with any instructional design or pedagogy experts or inclusion, diversity, and equity experts despite the potential of receiving insightful and invaluable information from them. This was primarily due to arranging logistics that could pass beyond the allotted time and scope of this research study. Additionally, working to find that information would have further extended the workload. Since this research study contributes to the self-guided learning module made for UNC SILS' information technology competency test, it was also not feasible within the time to get an environmental survey of what students of this college may need to be inclusive, diverse, and accessible. This particular content analysis could also be its own delimitation because of the fact that it only investigated a small sample of evaluation tools that I selected. It also used online resources from the existing competency test as well as online resources from compiled by only one individual, the SILS student researcher.

Since the SILS student researcher and I worked collaboratively only through the planning stages, it would be interesting to explore parts of our research extended further by future SILS students. It would be interesting to see the potential impact of the working guidelines used in other applications, specifically work done in SILS. It would also be interesting to evaluate the effectiveness of the working guidelines and what revisions could be incorporated especially with regards to its impact to SILS. Additionally, it would be particularly interesting to see if future researchers looked at our joint research as a kind of case study to be replicated in other capacities to develop and encourage more collaborative work amongst student researchers.

Conclusion

To deliberate and act on decisions that revolve around inclusive and equitable themes requires a human touch. Algorithms, created by humans, can affect a certain level of efficiency and change to streamline the work necessary to improve content and materials to be inclusive and equitable. In other words, algorithms can make the work easier. But it should always be secondary to the involvement of humans exercising their empathy and compassion so that learning can be accessible for all. As explored in this content analysis, evaluation tools scored and calculated data points that graded how online resources fared in the categories of accessibility, readability, and learning approaches. They may have produced valuable data, but its purpose and value fall short without human intervention parsing through those results and understanding the appropriate context for these online resources to exist.

Assessing online resources that supplement an information technology test is just one aspect of navigating the larger narrative of inclusive and equitable learning opportunities. This hopefully can further conversation about integrating inclusion and equity, accessibility and learning approaches as an inherent part of creating educational content and assessment and not as an afterthought. Doing so would position incoming students who are hailing from diverse learning backgrounds and experiences to approach their own learning from a place of strength.

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Appendix A

List of resources from the current SILS Information Technology Competency Test

https://bellard.org/jslinux/
http://validator.w3.org/#validate_by_upload
http://jigsaw.w3.org/css-validator/#validate_by_upload
https://www.file-extensions.org/extensions/common-file-extension-list
https://www.webopedia.com/TERM/W/word_processing.html
https://www.webopedia.com/TERM/S/spreadsheet.html
https://www.webopedia.com/TERM/R/RDBMS.html
https://support247webs.com/windows-traceroute/
https://support.cloudflare.com/hc/en-us/articles/203118044#h_b8cebafd-9243-40e9-9c44-d4b94ccd3a87

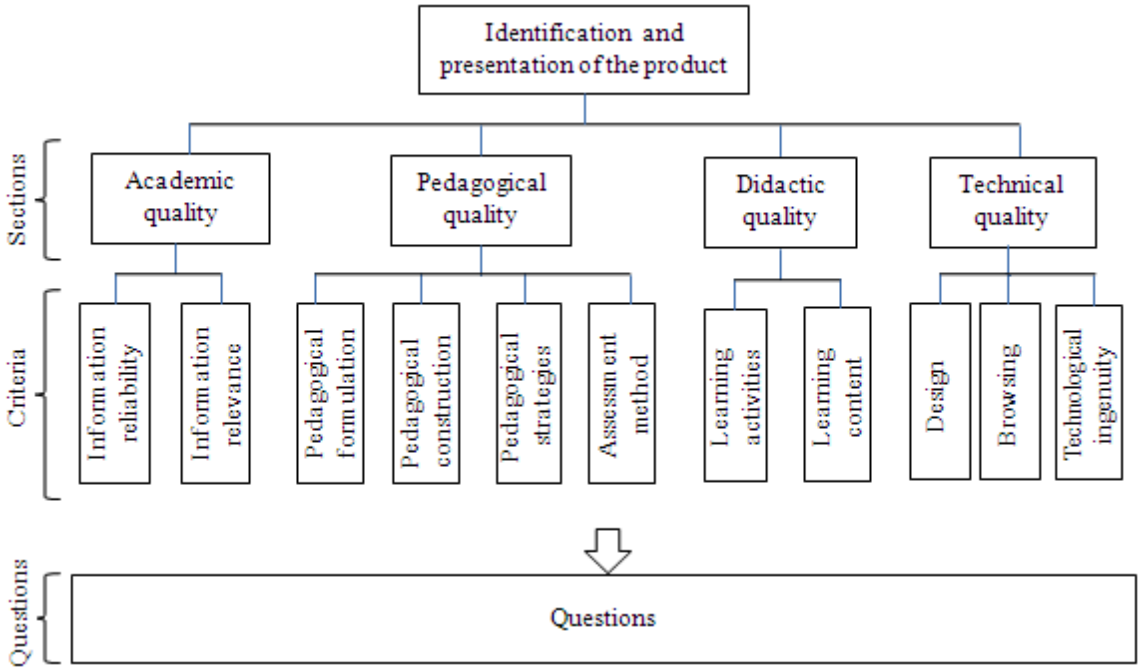
List of resources from SILS student researchers' self-guided learning module research project

https://www.w3schools.com/html/
https://www.w3schools.com/html/html_intro.asp
https://developer.mozilla.org/en-US/docs/Learn/HTML/Introduction_to_HTML/The_head_metadata_in_HTML#Metadata_the_%3Cmeta%3E_element
https://www.w3schools.com/html/html_lists.asp
https://www.linkedin.com/learning/html-essential-training/welcome?u=42563596
https://www.youtube.com/watch?v=sx4kaeyzQzw
https://www.youtube.com/watch?v=U4UHoiK6Oo4
https://www.w3schools.com/css/default.asp
https://www.w3schools.com/css/css_intro.asp
https://www.w3schools.com/css/css_howto.asp

https://www.w3schools.com/css/css_text.asp
https://www.w3schools.com/sql/default.asp
https://www.w3schools.com/sql/sql_select.asp
https://support.office.com/en-us/article/Video-What-is-Access-f2338765-ff59-4cfc-b8ba-74059fcb1874
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/access_2016_introduction.cfm
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/import_data_into_microsoft_access.cfm
https://www.qhmit.com/microsoft_access/microsoft_access_2016/tutorial/create_a_query_in_microsoft_access.cfm
https://database.guide/microsoft-access-tutorial/
https://support.office.com/en-us/article/Access-video-training-a5ffb1ef-4cc4-4d79-a862-e2dda6ef38e6
https://www.davidbaumgold.com/tutorials/command-line/
https://www.codecademy.com/learn/learn-the-command-line/modules/learn-the-command-line-navigation/reference
https://www.youtube.com/watch?v=jDINUSK7rXE

Appendix B

Evaluation Instrument tree structure (Mhouti et al., 2013)



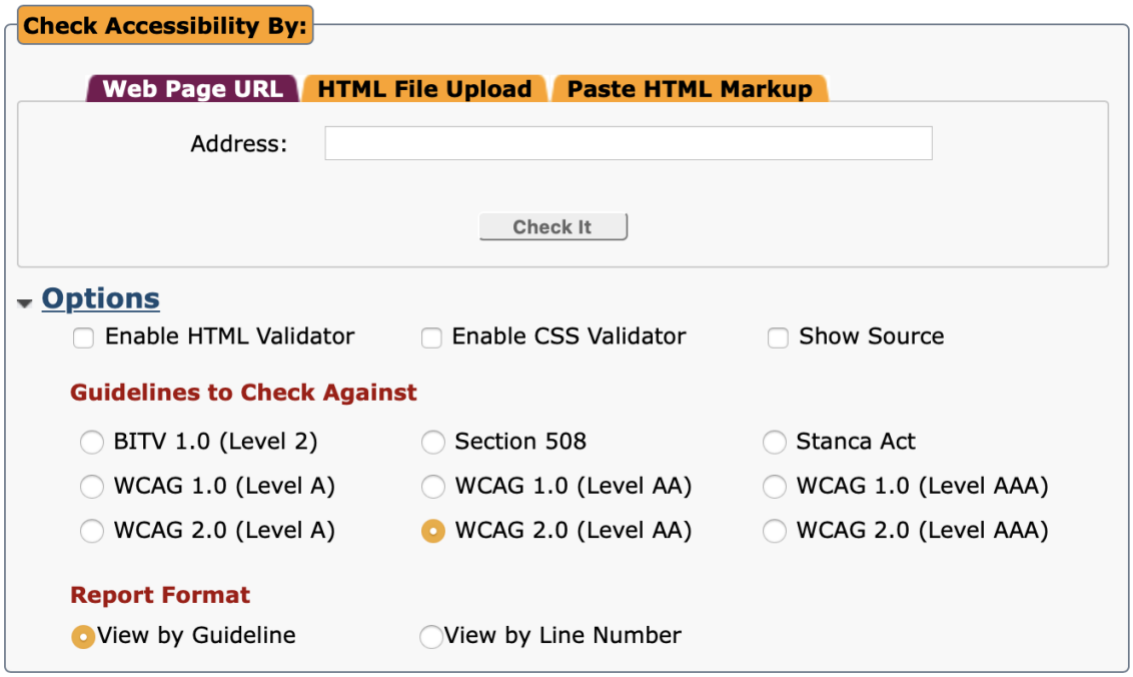
Appendix C

WAVE Tool Index

Errors:	Missing alternative text	Linked image missing alternative text	Spacer image missing alternative text	Image button missing alternative text	Image map area missing alternative text
	Image map missing alternative text	Invalid longdesc	Missing form label	Empty form label	Multiple form labels
	Broken ARIA reference	Broken ARIA menu	Missing or uninformative page title	Document language missing	Page refreshes or redirects
	Empty heading	Empty button	Empty link	Broken skip link	Empty table header
	Blinking content	Marquee			
Contrast Errors	Very low contrast				
Alerts	Suspicious alternative text	Redundant alternative text	A nearby image has the same alternative text	Long alternative text	Long description
	Orphaned form label	Unlabeled form element with title	Missing field set	Fieldset missing legend	No heading structure
	Missing first level heading	No page regions	Skipped heading level	Possible heading	Layout table
	Possible table caption	Broken same-page link	Suspicious link text	Redundant link	Link to Word document
	Link to Excel spreadsheet	Link to PowerPoint document	Link to PDF document	Link to document	Audio/video

	HTML5 video or audio	Flash	Java applet	Plugin	Noscript element
	Device dependent event handler	JavaScript jump menu	Accesskey	Tabindex	Very small text
	Justified text	Underlined text	Redundant title text		
Features	Alternative text	Null or empty alternative text	Null or empty alternative text on spacer	Linked image with alternative text	Image button with alternative text
	Image map with alternative text	Image map area with alternative text	Form label	Fieldset	Skip link
	Skip link target	Element language			
Structural Elements	Heading level 1	Heading level 2	Heading level 3	Heading level 4	Heading level 5
	Heading level 6	Ordered list	Unordered list	Definition/description list	Header
	Navigation	Search	Main content	Aside	Footer
	Data table	Table caption	Table header cell	Column header cell	Row header cell
	Inline frame				
ARIA	ARIA	ARIA label	ARIA description	ARIA alert or live region	ARIA menu
	ARIA button	ARIA expanded	ARIA popup	ARIA tabindex	ARIA hidden

AChecker's Options screenshot:



WebFX's Readability Test Tool terms (definitions for each term are sourced directly from the website)

- Flesch-Kincaid Reading Ease: is based on a ranking scale of 0-100, and the higher your score, the better. Low scores indicate text that is complicated to understand. So if your website receives a low Flesch-Kincaid reading ease score, you will likely need to simplify your text.
- Flesch-Kincaid Grade Level: tells you the American school grade you would need to be in to comprehend the material on the page.
- Gunning FOG Score: estimates the years of formal education needed to comprehend a passage of text on the first reading.
- Coleman Liau Index: is designed to evaluate the U.S. grade level necessary to understand the text. Instead of syllables per word and sentence lengths, the Coleman Liau Index relies on characters and uses computerized assessments to understand characters more easily and accurately.
- Automated Readability Index: is a readability test designed to measure the how easy your text is to understand. Similar to other popular readability tools, the ARI gives you an estimate of the U.S. grade level necessary to comprehend a passage of text.
- SMOG Index: estimates the years of education a person needs to comprehend a piece of writing, and it was created as an improvement of other readability formulas.

Reading Formulas' Automatic Readability Checker terms (definitions for each term are sourced directly from the website)

- Flesch-Kincaid Reading Ease: will output a number from 0 to 100 - a higher score indicates easier reading. An average document has a Flesch Reading Ease score between 6 - 70. As a rule of thumb, scores of 90-100 can be understood by an average 5th grader. 8th and 9th grade students can understand documents with a score of 60-70; and college graduates can understand documents with a score of 0-30.
- Flesch-Kincaid Grade Level: outputs a U.S. school grade level; this indicates the average student in that grade level can read the text. For example, a score of 7.4 indicates that the text is understood by an average student in 7th grade.
- Gunning FOG Score: is similar to the Flesch scale in that it compares syllables and sentence lengths. A Fog score of 5 is readable, 10 is hard, 15 is difficult, and 20 is very difficult. Based on its name, 'Foggy' words are words that contain 3 or more syllables.
- SMOG Index: outputs a U.S. school grade level; this indicates the average student in that grade level can read the text. For example, a score of 7.4 indicates that the text is understood by an average student in 7th grade.
- Coleman Liau Index: relies on characters instead of syllables per word and sentence length. This formula will output a grade. For example, 10.6 means your text is appropriate for a 10-11th grade high school student.
- Automated Readability Index: outputs a number which approximates the grade level needed to comprehend the text. For example, if the ARI outputs the number 3, it means students in 3rd grade (ages 8-9 yrs. old) should be able to comprehend the text.
- Linsear Write Formula: is a readability formula for English text, originally developed for the United States Air Force to help them calculate the readability of their technical manuals. Linsear Write Formula is specifically designed to calculate the United States grade level of a text sample based on sentence length and the number words used that have three or more syllables.